

CLAIMS

1. A fiber-compounded hydraulic reinforcing material comprising
at least following constitutive elements [A], [B] and [C], of
which binding of [A] and [C] is achieved through [B], and
having a property of being flexible before it contacts with
water, and of hardening on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

2. A fiber-compounded hydraulic reinforcing material as
described in claim 1 whose form is one chosen from the
following groups:

1) long fiber group comprising strands, rovings, ropes and
braids;

2) short fiber group which is obtained by cutting the
member of long fiber group into pieces of a specific length; and

3) web group comprising unidirectional sheet, fabric, net,
unwoven fabric and mat.

3. A fiber-compounded hydraulic reinforcing material as
described in claim 1 wherein the content of an organic binder
against the sum of [A], [B] and [C] is 0.1 - 40% in terms of
volume ratio.

4. A fiber-compounded hydraulic reinforcing material as described in claim 1 wherein the reinforcing fiber is carbon fiber or carbonaceous fiber.

5. A fiber-compounded hydraulic reinforcing material as described in claim 1 wherein the particle diameter of hydraulic inorganic powder is $0.1 \mu\text{m} - 100 \mu\text{m}$.

6. An package obtained by wrapping a fiber-compounded hydraulic reinforcing material as described in claim 1 in a moisture-proof packaging material.

7. A fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], in which a flexible hydraulic compound obtained by binding [A] and [C] through [B] hardens by hydration, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

8. A fiber-compounded hydraulic reinforcing material as described in claim 7 wherein the content of an organic binder against the sum of [A], [B] and [C] is 0.1 - 40% in terms of volume ratio.

9. A fiber-compounded hydraulic reinforcing material as described in claim 7 wherein the reinforcing fiber is carbon

fiber or carbonaceous fiber.

10. A fiber-compounded hydraulic reinforcing material as described in claim 7 wherein the form of the hydraulic compound is chosen from strands, rovings, ropes, braids, unidirectional sheet, fabric, net, unwoven fabric and mat.

11. A fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], in which one or more flexible hydraulic compound obtained by binding [A] and [C] through [B] is laminated or assembled and hardens by hydration, chosen from compound in the form of strands, rovings, ropes, braids, unidirectional sheet, fabric, net, unwoven fabric and mat, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

12. A fiber-compounded hydraulic reinforcing material as described in claim 7 or 11 wherein a hydraulic compound, or a laminated or assembled comprising one or more hydraulic compounds is molded along the walls of a mold when it hardens via hydration.

13. A fiber-compounded reinforcing material as described in claim 7 wherein the fiber-compounded reinforcing material takes the form of short fibers.

14. A fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], in which a flexible hydraulic compound in the form of short fibers obtained by binding [A] and [C] through [B] is molded at the same time when it hardens by hydration, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

15. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) preparing organic binder solution dispersing a hydraulic inorganic powder by using hydraulic inorganic powder, a dispersion medium to disperse the hydraulic inorganic powder, and an organic binder;

(2) applying the organic binder solution dispersing a hydraulic inorganic powder obtained in the foregoing step to reinforcing fiber, thereby causing the organic binder solution dispersing a hydraulic inorganic powder to bind to the surface of reinforcing fiber and/or to impregnate reinforcing fibers;

(3) subjecting the reinforcing fiber having a layer of organic binder solution dispersing hydraulic inorganic powder thereupon to a drying and/or heating treatment; and

(4) obtaining a fiber-compounded hydraulic reinforcing material binding the hydraulic inorganic powder around reinforcing fiber through an organic binder; contains at least

following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

16. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) dispersing hydraulic inorganic powder into organic binder solution;

(2) introducing reinforcing fiber into the thus obtained hydraulic inorganic powder dispersant, thereby causing the hydraulic inorganic powder dispersant to put on the surface of reinforcing fiber and/or the same dispersant to impregnate reinforcing fibers;

(3) subjecting the reinforcing fiber having a layer of organic binder solution dispersing hydraulic inorganic powder thereupon to a drying and/or heating treatment; and

(4) obtaining a fiber-compounded hydraulic reinforcing material binding the hydraulic inorganic powder around the reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property

to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

17. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) introducing reinforcing fiber into organic binder solution, thereby causing an organic binder put on the surface of reinforcing fiber and/or the same binder to impregnate reinforcing fibers;

(2) passing the reinforcing fiber having a layer of organic binder thereupon through a vessel containing hydraulic inorganic powder, thereby causing the hydraulic inorganic powder to bind to the reinforcing fiber;

(3) subjecting the reinforcing fiber having a layer of organic binder with hydraulic inorganic powder bound to a drying and/or heating treatment; and

(4) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bound around reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

5 18. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) dispersing hydraulic inorganic powder into organic solvent;

10 (2) introducing reinforcing fiber into the thus obtained hydraulic inorganic powder dispersant, thereby causing the hydraulic inorganic powder dispersant to put on the surface of reinforcing fiber and/or the same dispersant to impregnate reinforcing fibers;

15 (3) passing the reinforcing fiber having a layer of hydraulic inorganic powder thereupon through a vessel containing organic binder solution, or spraying organic binder solution onto the same reinforcing fiber, thereby coating the surface of reinforcing fiber with the organic binder, and/or infiltrating the organic binder between the reinforcing fibers;

20 (4) subjecting the reinforcing fiber having a layer of organic binder with hydraulic inorganic powder bound to a drying and/or heating treatment; and

25 (5) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bound around the reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains

flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder.

19. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) using a dispersion medium, hydraulic inorganic powder to be dispersed into said medium, ~~an~~ dissolving agent to dissolve an organic binder, an organic binder to be dissolved in said dissolving agent, and other admixtures to be used as needed, and causing at least one of said dispersion medium, said dissolving agent and said other admixtures to contain water, and

applying above components one after another in above order or simultaneously to reinforcing fiber, while using an setting retarding means to retard the setting of hydraulic inorganic powder, thereby causing the above components to bind to the surface of reinforcing fiber or to impregnate reinforcing fibers; and sequently

(2) depriving the reinforcing fiber having undergone the foregoing treatment of water and/or organic solvent derived from the dispersion medium, dissolving agent for organic binder, and other admixtures added as needed used in the foregoing step; and

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(3) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bound around the reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

20. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 19 wherein the step of using an setting retarding means comprises causing an setting retarder to be present in water to be used for hardening of hydraulic inorganic powder.

21. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 20 wherein the setting retarding effector is one or more chosen from a group comprising organic solvents, setting retarders and high performance setting retarders.

22. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 20 wherein the setting retarding effector is an organic solvent derived from

dispersants to disperse hydraulic inorganic powder.

23. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 19 wherein the step of using an setting retarding means to cause an setting retarder to be present in water to be used for hardening of hydraulic inorganic powder, comprises:

if the setting retarding effector is an organic solvent, causing the setting retarding effector to exist in water at 0 - 99 wt.% in terms of the ratio of organic solvent against the sum of water + organic solvent; or

if the setting retarding effector is one or more chosen from a group comprising setting retarders and high performance setting retarders, causing an setting retarding effector 1 - 5 weight parts to exist in water in terms of solid weight against hydraulic inorganic powder 100 weight parts.

24. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) taking water as a dispersion medium, adding thereto an hydrophilic organic binder and, as needed, one or more chosen from a group comprising setting retarders and highly-active retarders, and then causing hydraulic inorganic powder to disperse into said solution to produce a organic binder solution dispersing a hydraulic inorganic powder;

(2) applying the organic binder solution dispersing a hydraulic inorganic powder to reinforcing fiber before the same

binder solution completes hardening via hydration, thereby causing the organic binder solution dispersing a hydraulic inorganic powder to bind to the surface of reinforcing fiber and/or said binder solution to impregnate reinforcing fibers, and then subjecting the resulting reinforcing fiber to a drying and/or heating treatment; and

(3) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bind to the reinforcing fiber through a hydrophilic organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

25. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 15, ~~19 or 24~~ wherein the means by which to apply a hydraulic inorganic powder dispersant to reinforcing fiber comprises one chosen from:

an air doctor coater, blade coater, rod coater, knife coater, squeeze coater, immersing machine, reverse roll coater, transfer roll coater, gravure coater, kiss coater, coater based on cast coating or spray coating, slot orifice coater, and coater based on extrusion coating.

26. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 24 wherein the time required for applying the organic binder solution dispersing a hydraulic inorganic powder to reinforcing fiber before the same binder solution completes hardening via hydration, thereby causing the organic binder solution dispersing a hydraulic inorganic powder to bind to the surface of reinforcing fiber and/or said binder solution to impregnate reinforcing fibers; and for subjecting the resulting reinforcing fiber to a drying and/or heating treatment to deprive the reinforcing fiber of water is 15 minutes or less from the time when the hydraulic inorganic fiber dispersing organic binder solution has been prepared.

27. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 24 wherein the hydrophilic organic binder is chosen from water-soluble polymer binders, emulsions of various polymers and dispersants of various polymers.

28. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) adding, to organic binder solution obtained by dissolving an organic binder into water or an organic solvent, water or a dispersion medium containing a mixture of water and an organic solvent, and, as needed, one or more chosen from a

group comprising setting retarders and highly-active retarders, and then causing hydraulic inorganic powder to disperse into the thus obtained solution;

(2) introducing reinforcing fiber into the thus obtained organic binder solution dispersing a hydraulic inorganic powder, thereby causing the organic binder solution dispersing a hydraulic inorganic powder to bind to the surface of reinforcing fiber and/or said binder solution to impregnate reinforcing fibers;

(3) subjecting the reinforcing fiber as treated in the foregoing step to a drying and/or heating treatment, thereby depriving the reinforcing fiber of water and/or organic solvent; and

(4) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bound to the reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

29. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

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5 (1) dissolving an organic binder into water or an organic solvent, adding, as needed, one or more chosen from a group comprising setting retarders and highly active retarders, and then introducing reinforcing fiber into the resulting organic binder solution, thereby causing the organic binder solution to put on the surface of reinforcing fiber and/or said binder solution to impregnate reinforcing fibers,

10 (2) passing the reinforcing fiber having a layer of organic binder thereupon through a vessel containing hydraulic inorganic powder, thereby causing the hydraulic inorganic powder to bind to the reinforcing fiber;

15 (3) subjecting the reinforcing fiber as treated in the foregoing step to a drying and/or heating treatment, thereby depriving the reinforcing fiber of water and/or organic solvent; and

20 (4) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bound to the reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

25 [A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

30. A method for producing a fiber-compounded hydraulic reinforcing material comprising the steps of:

(1) adding, to water or a dispersion medium obtained by mixing water and an organic solvent, as needed one or more chosen from a group comprising setting retarders and highly-active retarders, and then dispersing hydraulic inorganic powder therein;

(2) introducing reinforcing fiber into the thus obtained hydraulic inorganic powder dispersant, thereby causing the hydraulic inorganic powder dispersant to put on the surface of reinforcing fiber and/or said dispersant to impregnate reinforcing fibers;

(3) passing the reinforcing fiber as processed in the foregoing step through a vessel containing organic binder solution obtained by dissolving an organic binder into water or an organic solvent, thereby causing the reinforcing fiber to contact with the organic binder solution, or spraying the organic binder solution onto the reinforcing fiber, thereby coating the surface of reinforcing fiber with the organic binder and/or causing the organic binder to impregnate reinforcing fibers;

(4) subjecting the reinforcing fiber as treated in the foregoing step to a drying and/or heating treatment, thereby depriving the reinforcing fiber of water and/or organic solvent; and

(5) obtaining a fiber-compounded hydraulic reinforcing material which has hydraulic inorganic powder bound to the

reinforcing fiber through an organic binder; contains at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and is dry; retains flexibility before it contacts with water; and has a property to let hydration/hardening reaction proceed on contact with water, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

31. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 15, ~~16, 17, 18, 19, 28, 29 or 30~~ wherein the organic binder is a water-soluble polymer binder.

32. A method for producing a fiber-compounded hydraulic reinforcing material as described in claim 19, ~~24, 28, 29 or 30~~ wherein the other admixtures to be used as needed are one or more chosen from a group comprising water reducing admixture, air entraining water reducing admixture, high performance water reducing admixture, fluidizers, setting retarders, high performance setting retarders, and polymer dispersants for cement mixture.

33. A method for producing a fiber-compounded hydraulic reinforcing material wherein a fiber-compounded hydraulic reinforcing material produced by a method as described in claim

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15, 16, 17, 18, 19, 24, 28, 29 or 30 is further cut into pieces of a specific length to give a fiber-compounded hydraulic reinforcing material in the form of chopped strands.

5 34. A method for producing a fiber-compounded hydraulic reinforcing material wherein one or a few fiber-compounded hydraulic reinforcing materials produced by a method as described in claim 15, 16, 17, 18, 19, 24, 28, 29 or 30 are further bundled, and then the bundles are woven or knit into fabric or net.

10 35. A method for producing a fiber-compounded hydraulic reinforcing material wherein fiber-compounded hydraulic reinforcing materials produced by a method as described in claim 15, 16, 17, 18, 19, 24, 28, 29 or 30 are pulled side by side in one direction, and spread like a sheet to give a unidirectional sheet.

20 36. A method for producing a fiber-compounded hydraulic reinforcing material wherein two or several fiber-compounded hydraulic reinforcing materials produced by a method as described in claim 15, 16, 17, 18, 19, 24, 28, 29 or 30 are put together and twisted into a cord, and the cords are bundled and twisted to give a fiber-compounded hydraulic reinforcing material in the form of ropes or braids.

25 37. A method for reinforcing/repairing a construction

comprising the steps of:

5 applying a fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water, onto the application surface of a construction, and

10 causing the fiber-compounded hydraulic reinforcing material to harden via hydration on that application surface, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

15 38. A method for reinforcing/repairing a construction as described in claim ³⁷~~36~~ wherein the construction is made from one or more materials chosen from concrete and steel.

20 39. A method for reinforcing/repairing a construction as described in claim 37 wherein the step of hardening via hydration a fiber-compounded hydraulic reinforcing material on a application surface is performed in accordance with one or more chosen from the following processes (1) to (3):

25 (1) process in which a application surface is wetted with water in advance, and a fiber-compounded hydraulic reinforcing material is applied thereto;

(2) Process in which a fiber-compounded hydraulic

reinforcing material is applied to a application surface and then water is sprayed over it; and

(3) process in which water is given to a fiber-compounded hydraulic reinforcing material, and the wetted material is applied to a application surface.

40. A method for reinforcing/repairing a construction as described in claim 37 wherein the step of applying a fiber-compounded hydraulic reinforcing material onto a application surface comprises applying a fiber-compounded hydraulic reinforcing material alone, or after a precoat comprising one or more chosen from water, polymer dispersant for cement mixture, cement mortar and polymer cement mortar has been applied, onto the application surface.

41. A method for reinforcing/repairing a construction or natural object wherein the step of applying a fiber-compounded hydraulic reinforcing material of a method for reinforcing/repairing a construction as described in claim 37 comprises the use of a fiber-compounded hydraulic reinforcing material whose form is one, or two or more combined chosen from the following categories (1) to (4):

(1) fiber-compounded hydraulic reinforcing material in the form of one or more chosen from strands, rovings, ropes and braids;

(2) fiber-compounded hydraulic reinforcing material in the form of fabric or net;

(3) fiber-compounded hydraulic reinforcing material in the form of unwoven fabric or mat; and

(4) fiber-compounded hydraulic reinforcing material in the form of the unidirectional sheet obtained by processing fiber-compounded hydraulic reinforcing materials classified to category (1).

42. A method for reinforcing/repairing a construction as described in claim 37 wherein the content of an organic binder contained in the fiber-compounded hydraulic reinforcing material against the sum of [A], [B] and [C] is 0.1 - 40% in terms of volume ratio.

43. A method for reinforcing/repairing a construction as described in claim 37 wherein the reinforcing fiber is carbon fiber or carbonaceous fiber.

44. A method for reinforcing/repairing a construction as described in claim 37 wherein the step of applying a fiber-compounded hydraulic reinforcing material onto the application surface of a construction comprises application of a fiber-compounded hydraulic reinforcing material whose form is chosen from unidirectional sheet, fabric, net, unwoven fabric and mat.

45. A method for reinforcing/repairing a construction as described in claim 37 wherein the step of applying a fiber-compounded hydraulic reinforcing material onto the application

surface of a construction comprises winding a fiber-compounded hydraulic reinforcing material in the form of strands, rovings, ropes or braids round the application surface;

5 46. A structure for reinforcing/repairing a construction wherein a fiber-compounded hydraulic reinforcing material containing reinforcing fiber, an organic binder and unhardened and dry hydraulic inorganic powder in combination hardens via hydration on the application surface of a construction, thereby integratively uniting with the construction.

10 47. A structure for reinforcing/repairing a construction wherein the structure for reinforcing/repairing a construction as described in claim 46 is based on a fiber-compounded hydraulic reinforcing material whose form is one, or two or more chosen from the following categories (1) to (4):

(1) fiber-compounded hydraulic reinforcing material in the form of one or more chosen from strands, rovings, ropes and braids;

20 (2) fiber-compounded hydraulic reinforcing material in the form of fabric or net;

(3) fiber-compounded hydraulic reinforcing material in the form of unwoven fabric or mat; and

25 (4) fiber-compounded hydraulic reinforcing material in the form of the unidirectional sheet obtained by processing the fiber-compounded hydraulic reinforcing materials classified to category (1).

48. A method for reinforcing/repairing a construction comprising the step of:

5 applying a fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], in which a flexible hydraulic compound obtained by binding [A] and [C] through [B] has hardened via hydration, onto the application surface of a construction wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

49. A method for reinforcing/repairing a construction or natural object comprising the steps of:

15 (1) applying a fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water, onto the application surface of a construction or natural object, or onto the application surface of a construction or natural object given a precoat material;

20 (2) heaping and/or spraying concrete slurry around the fiber-compounded hydraulic reinforcing material to overlay the hydraulic reinforcing material, thereby hydrating the latter; and

25 (3) causing the hydraulic reinforcing material and

concrete slurry to harden concurrently to form a unified mass,
wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder.

50. A method for reinforcing/repairing a construction or natural object wherein the step of applying a fiber-compounded hydraulic reinforcing material of a method for reinforcing/repairing a construction or natural object as described in claim 49 comprises using one or combining two or more chosen from fiber-compounded hydraulic reinforcing materials whose form is chosen from the following categories (1) to (4):

(1) fiber-compounded hydraulic reinforcing material in the form of one or more chosen from strands, rovings, ropes and braids;

(2) fiber-compounded hydraulic reinforcing material in the form of fabric or net;

(3) fiber-compounded hydraulic reinforcing material in the form of unwoven fabric or mat; and

(4) fiber-compounded hydraulic reinforcing material in the form of the unidirectional sheet obtained by processing the fiber-compounded hydraulic reinforcing materials classified to category (1).

51. A method for reinforcing/repairing a construction or natural object as described in claim 49 wherein the construction

is made from one or more materials chosen from concrete, steel and natural objects.

5 52. A method for reinforcing/repairing a construction or natural object as described in claim 49 wherein the step of applying a fiber-compounded hydraulic reinforcing material onto the surface of a construction or natural object requiring reinforcement/repair comprises winding a fiber-compounded hydraulic reinforcing material round the application surface.

10 53. A method for reinforcing/repairing a construction or natural object as described in claim 49 wherein the precoat material is chosen from polymer dispersants for cement mixture, or polymer cement mortar slurry, cement mortar slurry and cement concrete slurry.

15 54. A method for reinforcing/repairing a construction or natural object as described in claim 49 wherein concrete slurry has been given a fiber-compounded reinforcing material in the form of the short fibers comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water, wherein:

25 [A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

55. A structure for reinforcing/repairing a construction or natural object wherein a fiber-compounded hydraulic reinforcing material containing reinforcing fiber, an organic binder and unhardened and dry hydraulic inorganic powder in combination lies below an overlying layer of concrete slurry on the application surface of a construction or natural object, so that the fiber-compounded hydraulic reinforcing material undergoing hydration and concrete slurry harden together to form a unified mass.

56. A structure for reinforcing/repairing a construction or natural object as described in claim 55 wherein the fiber-compounded hydraulic reinforcing material is one or more chosen from fiber-compounded hydraulic reinforcing materials whose form is classified to the following categories (1) to (4):

(1) continuous fiber whose form is one or more chosen from strands, rovings, ropes and braids;

(2) fabric or net woven from continuous fiber whose form is one or more chosen from strands, rovings, ropes and braids;

(3) unwoven fabric or mat obtained by taking continuous fibers whose form is one or more chosen from strands, rovings, ropes and braids, or cutting the continuous fibers into pieces, and connecting them physically and chemically; and

(4) sheet obtained by processing continuous fiber whose form is one or more chosen from strands, rovings, ropes and braids.

57. A method for reinforcing/repairing a construction or natural object comprising the step of:

(1) applying a fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], in which a flexible hydraulic compound obtained by binding [A] and [C] through [B] has hardened via hydration, onto the application surface of a construction or natural object, or onto the application surface given a precoat material;

(2) heaping and/or spraying concrete slurry around the fiber-compounded hydraulic reinforcing material to overlay that hydraulic reinforcing material; and

(3) causing concrete slurry to harden to form a unified mass with the underlaying reinforcing material, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

58. A method for reinforcing/repairing a construction or natural object wherein [a fiber-compounded reinforcing material in the form of short fibers comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water, and ~~cement-based slurry~~] are caused to harden together to form a unified mass on the surface of a construction or natural object requiring reinforcement/repair,

wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder.

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59. A method for reinforcing/repairing a construction or natural object comprising the steps of:

(1) preparing a fiber-compounded reinforcing material in the form of continuous fiber comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water; and

(2) cutting the fiber-compounded hydraulic reinforcing fiber in the form of continuous fiber into the short fibers, while spraying the obtained short fibers onto the application surface of a construction or natural object, concurrently or alternately with spraying of cement-based slurry, thereby causing the short fiber-compounded hydraulic reinforcing material and cement-based slurry to harden together to form a unified mass, wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder.

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60. A method for reinforcing/repairing a construction or natural object comprising the steps of:

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5 (1) preparing a fiber-compounded reinforcing material in the form of short fibers comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water;

10 (2) kneading the fiber-compounded hydraulic reinforcing material in the form of short fibers together with mixing materials containing cement, aggregate and water, thereby obtaining fiber-compounded cement-based slurry; and

15 (3) spraying the fiber-compounded cement-based slurry on the application surface of a construction or natural object, or placing the fiber-compounded cement-based slurry into a mold assembled in advance on the application surface of a construction or natural object, thereby causing the short fiber-compounded hydraulic reinforcing material and cement-based slurry to harden together to form a unified mass, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

20 [C] Unhardened and dry hydraulic inorganic powder.

Product

25 61. A structural element wherein a fiber-compounded hydraulic reinforcing material obtained by binding hydraulic inorganic powder to reinforcing fiber through an organic binder is buried in hardening state below a hardened cement manufacture which also serves as a component of the structural element, or has a hardened cement manufacture applied thereupon, thereby

reinforcing that cement manufacture.,

62. A structural element wherein a fiber-compounded hydraulic reinforcing material resulting from hardening a fiber-compounded hydraulic compound comprising hydraulic inorganic powder bound to reinforcing fiber through an organic binder is buried below a hardened cement manufacture which also serves as a component of the structural element, or has a hardened cement manufacture applied thereupon, thereby reinforcing that cement manufacture.

63. A structural element wherein a fiber-compounded reinforcing material in the form of short fibers comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water, is buried in hardening state below a hardened cement manufacture which also serves as a component of the structural element, thereby reinforcing that hardened cement manufacture, wherein:

[A] Reinforcing fiber;

[B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

64. A structural element as described in claim 61, ~~62 or 63~~ wherein the content of an organic binder contained in the fiber-compounded hydraulic reinforcing material against the sum

of reinforcing fiber, an organic binder and hydraulic inorganic powder is 0.1 - 40% in terms of volume ratio.

a 65. A structural element as described in claim 61, ~~62 or 63~~
5 wherein the reinforcing fiber is carbon fiber or carbonaceous fiber.

a 66. A structural element as described in claim 61, ~~62 or 63~~
10 wherein the fiber-compounded hydraulic reinforcing material takes one or more forms chosen from sheet, strands, rovings, unidirectional sheet, ropes, braids, fabric, net, unwoven fabric and mat.

004440 59229460 15 67. A method for preparing a structural element comprising the steps of:

20 (1) preparing a fiber-compounded reinforcing material comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water;

(2) placing the fiber-compounded hydraulic reinforcing material, or hardened fiber-compounded hydraulic reinforcing material into a mold for manufacture of a structural element, and then filling the mold with cement-based slurry; and

25 (3) causing the hydraulic reinforcing material and cement-based slurry to harden together to form a unified mass, thereby obtaining a structural element, wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder.

5 68. A method for preparing a structural element as described in claim 67 wherein excess water is removed by suction which is generated during the process in which hydraulic inorganic powder of the hydraulic reinforcing material and cement-slurry filling the mold harden together.

10 69. A method for preparing a structural element comprising the steps of:

15 (1) preparing a fiber-compounded reinforcing material in the form of continuous fiber comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water;

20 (2) introducing continuously the fiber-compounded hydraulic reinforcing material into an extruder, and, while feeding cement-based slurry into the extruder, continuously extruding from the outlet the fiber-compounded hydraulic reinforcing material embedded in cement-based slurry; and

(3) obtaining hardened extrusion products cut as needed,

25 wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and

[C] Unhardened and dry hydraulic inorganic powder.

70. A method for preparing a structural element as described in claim 67 ~~or 69~~ wherein the fiber-compounded hydraulic reinforcing material takes one or more forms chosen from strands, rovings, ropes, braids, fabric and net.

71. A method for preparing a structural element as described in claim 67 ~~or 69~~ wherein cement-slurry containing a fiber-compounded hydraulic reinforcing material in the form of short fibers is used.

72. A method for preparing a structural element comprising the steps of:

(1) preparing a fiber-compounded reinforcing material in the form of continuous fiber comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water;

(2) cutting the fiber-compounded hydraulic reinforcing fiber in the form of continuous fiber into the short fibers of a specific length, while spraying the obtained short fibers, concurrently or alternately with spraying of cement-based slurry, into a mold to fill up; and

(3) causing the fiber-compounded hydraulic reinforcing material in the form of short fibers and cement-based concrete

slurry in the mold to harden together to form a unified mass, and removing the mass from the mold, thereby obtaining a structural element, wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder.

73. A method for preparing a structural element as described in claim 72 wherein excess water is removed by suction which is generated during the process in which the short fiber-compounded hydraulic reinforcing material and cement-slurry introduced by spraying into the mold harden together.

74. A method for preparing a structural element comprising the steps of:

(1) preparing a fiber-compounded reinforcing material in the form of short fibers comprising at least following constitutive elements [A], [B] and [C], of which binding [A] and [C] is achieved through [B], and having a property of being flexible before it contacts with water and hardening on contact with water, wherein:

- [A] Reinforcing fiber;
- [B] Organic binder; and
- [C] Unhardened and dry hydraulic inorganic powder;

(2) kneading the fiber-compounded hydraulic reinforcing material in the form of short fibers together with mixing materials containing cement, aggregate and water, to give

cement-based slurry;

(3) introducing the cement-based slurry into a mold; and

(4) molding the cement-based slurry by one chosen from the following processes i) - iv), thereby causing the hydraulic reinforcing material and cement-based slurry to harden together to form a unified mass, and removing the mass from the mold to obtain a structural element, wherein:

i) process in which molding is achieved by spraying the cement-based slurry into a mold;

ii) process in which molding is achieved by placing the cement-based slurry into a mold;

iii) process in which molding is achieved by placing the cement-based slurry into a mold and then pressing it; and

iv) process in which extrusion molding is utilized.

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